INDIGENOUS? WHAT INDIGENOUS KNOWLEDGE? BELIEFS and ATTITUDES of RURAL PRIMARY SCHOOL TEACHERS TOWARDS INDIGENOUS KNOWLEDGE in the SCIENCE CURRICULUM in ZIMBABWE

EDWARD SHIZHA

Wilfrid Laurier University, Brantford Campus, 73 George Street, Brantford, Ontario, N3T 2Y3, Canada

Abstract

Despite the end of colonialism, Zimbabwean rural school teachers still find themselves trapped in the colonial pedagogic practices that undervalue the importance of rural school children's experiential knowledge in science. This article explores the beliefs and attitudes of rural primary teachers towards incorporating Indigenous knowledge and Indigenous teaching practices in science education. A case study of 10 teachers in a rural school in Zimbabwe was conducted using the observation method which was complimented with a semi-structured interview. Twenty video recordings were carried out while the teachers were conducting science lessons. Classroom interactions and communications were vividly captured and analysed, while interviews were conducted after observations to capture explanatory details that may not have been apparent during video recordings. Inductive data analysis focusing on themes relating to teachers' views and practices yielded rich and informative details. Findings indicate that teachers are reluctant to integrate Indigenous knowledge and teaching techniques as pedagogical tools. The attitudes are a result of systemic and institutional expectations on teachers.

Introduction

One of the issues confronting schooling in Zimbabwe is the extent to which science education values Indigenous cultures. Many students are reportedly not competent in school science, not because of innate inability, but pedagogical methodologies and practices that alienate students from their experiential knowledge. Science curriculum and pedagogical practices discriminate against Indigenous epistemologies and ontologies in favour of Western "scientific" practices. Pedagogy serves as a mechanism for cultural reproduction, so that for those students whose cultures are different from the school culture and pedagogy, understanding school science becomes a difficult task. This article examines and describes teachers' attitudes towards integrating Indigenous knowledge in primary school science curriculum in Zimbabwe.

What is Indigenous knowledge?

There are many ways of conceptualising and defining Indigenous knowledge. When we speak of Indigenous knowledge (IK), meanings and terminologies become quite varied as they are based on cultural, social, political, and ideological definitions. The fashionable perspective about Indigenous knowledge has been that of uncodified knowledge that is often generally considered not compatible with positivist methods, and not compatible with modern Western science. The popular perspective in this regard is captured by Warren's (1991) definition that:

> Indigenous knowledge (IK) is the local knowledge – knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-

> resource management, and a host of other activities in rural communities.

There is an assumption that IK contradicts Western knowledge and the formal scientific approach. While there may be some differences in basic assumptions between the two types of knowledge, there is certainly overlap between the two. IK has features and characteristics that allow for adaptation and appropriation, making some IK indistinguishable from Western knowledge.

Science: A Western epistemology

In contrast to Indigenous knowledge, "modern" Western science which is often perceived as Western knowledge is considered as "the acquisition of systematised knowledge in any sphere of life by methods that are based upon objectively verifiable sense experience" (Makhurane, 2000, p. 64). Therefore, science is replicable observation, description, prediction, and experimentation related to the physical world. Western science relies on the assurance that what is taught is researched and proven/tested according to recognised, documented and accepted standards. Because "modern" Western science is perceived as an intellectual activity designed to discover information about the natural world and to discover the ways in which this information can be organised into meaningful patterns, this has been adopted as the rationale for teaching Western science in schools.

The primary aim of science is simply to formulate and test hypotheses based on observational evidence; experiments are important where applicable, but their function is merely to simplify observation by imposing controlled conditions. An ultimate purpose of science is to discern the order that exists between and amongst the various facts. Teachers are happy to teach this empirical knowledge because its epistemology and pedagogy are also predetermine, while Indigenous science is contextual and situational, making teachers find difficulty in teaching it. None the less, science education that transmits a unilogical, assimilative discourse, especially Eurocentric scientific knowledge that does not value cultural diversity in knowledges is even of greater concern.

The intersection between Indigenous knowledge and Western science

There is a danger in measuring the value of IK from a monolithic Western science worldview. Western science does not reflect the diversity and plurality of the world and is colonial in that it tends to subjugate local culture by patronising locals and their different processes of extracting knowledge from their local ecosystem (Shizha, 2006). Generally, "modern" science considers oral traditions and local beliefs to be ignorant, primitive, superstitious, and inferior pseudo-science (Shizha, 2006). Another caution for examining IK from a Western worldview is that there is a tendency for the Western view to take on a "superior" trait that allows the user to decontextualise, apply reductionism and value judgments about the needs and realities of local people.

The existence of IK is a contentious question because it represents a clash of worldviews and experience. Sandra Harding suggests that although,

> there are clearly obvious and large differences between modern sciences and the traditions of seeking systematic knowledge of the natural world to be found in other cultures, it is useful to think of them all as sciences in order to gain a more objective understanding of the causes of Western successes, the achievement of other sciences, and possible direction for future local and global sciences (1994, p. 309).

Harding (1994, p. 310) pushes her argument towards the possibility of a de-centred global science in which "there would be many culturally distinctive scientific traditions that share some common elements with modern Western science". Unfortunately, science education is based on "modern" Western science ignoring cultural hybridity which can result in cultural transformation in science. In addition, teachers in Zimbabwe are educated within a Western scientific framework that pre-disposes them to easily dismiss the value of Indigenous perspectives, suspecting that they might simply be "unprovable myths" or "misconceptions", but certainly not contributions to scientific understanding.

Why Indigenous knowledge in science curriculum in Zimbabwe?

Science education in primary school in Zimbabwe is presented as study of environmental concepts (Curriculum Development Unit, 1994). The curriculum emphasises development of an awareness of the environment of the child. Concepts of life science, physical processes, basic scientific skills and content are introduced to the learners. Since primary school science focuses on the immediate environment of the child, one would expect the science epistemology, ontology, and pedagogical methods and practices to be strongly linked to the socio-cultural milieu of the community the school is located in. But this is not the case – science education in Zimbabwe is based on Western science epistemology and taught following positivist pedagogical practices inherited during colonialism. The science pedagogy emphasises investigation and experimentation as the main methodologies in teaching science in primary schools (Curriculum Development Unit, 1994). These are

methods and techniques employed when empiricism is the dominant perspective used in teaching science.

Generally, there is cultural conflict between an Indigenous worldview and that of Western science that is taught as formal knowledge in school. For example, in Zimbabwe, teachers discourage students in rural areas from chewing fibre from a tree known as mugang'acha because the teachers feel it is a valueless and unhygienic bad habit. However, the fibre cleans and strengthens teeth and the sap is sweet, nutritious and treats stomach pain. Its nutritional and medicinal significance is valued within the Shona culture (Shizha, 2007). This valuable Indigenous knowledge should be incorporated into the science curriculum as it reflects science, though some critics might see it as common sense untested knowledge.

The negation of alternative ways of explaining the world maintains cognitive imperialism that denigrates some forms of knowledge. Thomson's (2003) study of Keiyo science affirmed that there are sciences in people's languages, which science educators need to unravel, while I (Shizha, 2005a) illustrate that there are funds of knowledge in local communities, and science teachers need to tap such knowledge by working with them. In Nigeria, both informal knowledge from the community and formal school science are practiced in different contexts and their linkage is advocated (Seweje, 2000).

Aikenhead (1997), working with Aboriginal students in Canada, found that some students discovered that they already possessed some of the Aboriginal knowledge that was important for scientific conceptualisation. The knowledge had been taught at home, but it was not highly valued at school as legitimate knowledge for school science. Likewise in Zimbabwe home experiences are found in science lessons, for example, vegetables are boiled during preparation for meals and usually they boil until they lose their green colour (chlorophyll). Suppose a Zimbabwean student is studying photosynthesis in school and comes across terms such as "chlorophyll," "denaturing," and "chloroplast," the meal preparation at home can be a vital resource of learning these terms. To reduce the possibility of having problems comprehending these concepts school science can be made interesting and vivid by bringing the kitchen into the classroom or asking students to observe the mother cooking vegetables at home (Shizha, 2007). Invariably, since science exists as people's science or people's knowledge in the form of IK, school curriculum needs to be inclusive of people's science to enhance local students comprehend scientific knowledge and principles that they face in their everyday situations.

Inclusive curriculum and pedagogic discourse of science

Of concern in African schools, including in Zimbabwe is the continued isolation and marginalisation of Indigenous sciences in the national science curriculum. In Zimbabwe, I (Shizha, 2006) have reported that the top-down approach in which the curriculum is designed and implemented seems to underrate teachers' role in curriculum planning and implementation. Ogunniyi (2007) also observes that the lack of clarity on how a Science-IK curriculum could be implemented is a hindrance to integration of Indigenous science in the national science curriculum.

Ball (2004) posits that a "generative curriculum model" which brings Indigenous knowledge into the process of teaching and learning, and considered alongside Euro-Western theory, research, and practice is needed to promote Indigenous sciences in science education. As Michie (2002) has argued, a Science-IK curriculum that reflects valid images of both systems of thought provides Indigenous and non-Indigenous students access to different ways of knowing and interpreting scientific experience, and they strongly advocate the inclusion of Indigenous science in the conventional science curriculum for purposes of encouraging minority students' advancement in the field of science and removing educational barriers that may result in some students being left behind.

For example in Zimbabwe ethnoscience: community knowledge and personal observation within the local environment covers pertinent angles often overlooked or neglected by the "objective positivist techniques" that are being taught in schools. Indigenous people can predict droughts as well as weather related diseases by watching the movements of celestial bodies in combination with observing the date of emergence of certain plant species and pests which might affect their crops. Such "early warning signals" of an approaching environmental disaster are used to determine any preventive measures, prepare for mitigation and decide on the course of the community in using the natural resources. Similarly, estimates of animal fertility can be drawn from such forecasts with implication on stocking rates and density. This knowledge is little used in schools and less researched so far. The VaTonga and VaKorekore in the Zambezi Valley of Zimbabwe learn names of animals and plants, their behavioral patterns and ecological factors under which they flourish. They keep inventory of species and records of those, which disappear. They assign names to new plants and animals. The taxonomy reflects the use of plants for medicinal, social, economic or cultural usefulness or other determining characteristics, as in the case of poisonous plants. Sometimes biological or ecological features of the species are reflected in the names, such as muchetura (for poisonous plant). This taxonomy of important species is then incorporated into everyday knowledge of the community which is scientific knowledge that can be incorporated into the science curriculum. Knowledge of traditional practices has not yet sufficiently been integrated

into the formal educational and health domains in Zimbabwe, a missed opportunity for culturally-appropriate programmes.

Inclusivity in the science curriculum should be undertaken in good faith and not to demean Indigenous knowledges. Ninnes (2000) found that in Canadian and Australian schools a variety of the social life and activities of Indigenous people are presented in the *Science Probe* and *Dynamic Science* texts respectively. However, McConaghy (1998) found that the representations of Indigenous people in these texts tended to be "traditional" and stereotypical and concluded that these types of presentations represent a form of cultural imperialism. Hodson (cited in Ninnes, 2000), also comments that the kinds of presentations of Indigenous people in both Canadian and Australian textbooks, rather than boosting the self-esteem or enhancing minority groups' success in science, are careless and insensitive representations that may act against the interests of Indigenous students.

Research on the importance of Indigenous knowledge and languages in science curriculum in African schools reveal that a generative curriculum model that integrates both forms of knowledges can help students understand science that is taught in schools. Clark and Ramahlape (1999), in a study on students' understanding of the concept "lightning" in South Africa, discovered that students could learn without fear or threat of ridicule from peers and teachers and engage actively in classroom discussions around something that was rooted in their cultural experiences. They concluded that students underachieved in science because the subject is stereotypically rooted in essentialism and absolutism, and presented as a fixed body of knowledge and as absolute "truth" in conventional textbooks and teaching.

Teachers' beliefs and cultural science

For over a decade, studies in teacher education have shown the influence of teachers' beliefs about teaching and learning on classroom practice (Bryan & Atwater, 2002). Teachers' beliefs and lack of knowledge about a discipline of knowledge determine teachers' pedagogic practices in the classroom (Shizha, 2005b). Michie (2002) found out that teachers in Australian aboriginal schools, especially in secondary schools, tend to lack knowledge on Indigenous science. In South Africa, Ogunniyi (2007) found out that teachers' opposed Indigenisation and contextualisation of science due to the historical and traditional preparation of teachers who were schooled in Western science and hence are more familiar with that worldview than that of IK. Thomson (2003) affirmed the foregoing knowledge deficiency concerning secondary school teachers through his personal experience while teaching in Africa.

Language and Indigenous science

Indigenous languages can be used as a pedagogic tool to enhance understanding and self-expression in teaching and learning science. There are problems in using English as the instructional language in African classrooms. Greater concern should be directed towards deconstructing the primitive discourse associated with the use of Indigenous languages in science education since all communities understand their ecosystems through their language.

The benefit of learning science in Indigenous languages has been documented in various studies in Africa. Based on a longitudinal study in Nigeria, Bamgbose (1984) concluded that children taught in the home language performed significantly better than those in a control group in all subjects, including English. In a Kenyan study, Cleghorn (1992) discovered that when code switching into home language was used to foster understanding of key concepts, Grade 5 Kenyan students could use the home language (in this case Kikuyu) to write about the contents of a science lesson on water. In another study in Kenya, Bunyi (1999) found that when the use of English dominated in science instruction, students could not apply what they had learned to practical situations at home, thus documenting the subtractive nature of English. Murila (2004) observes that in Kenya primary school students use a lot of Kiswahili when doing group activities in science and concludes that the mother-tongue facilitates learning conversations since students would be using a language that is familiar and easy to use. All these studies reveal the importance of using the home language to enhance students' understanding of science and making it meaningful to their realities. Startlingly, Arua and Magocha (2002) report that in Botswana no teacher-respondent in their study preferred teaching science in Ikalanga, a minority Indigenous language. In a study carried out in South Africa, Chick (2002) also found out that administrators and teachers explicitly rejected the use of Zulu in science classes. Teacher attitudes can act as a barrier to integrating Indigenous languages into the science curriculum.

Methodology

The purpose of the study was to establish primary school teachers' meanings and attitudes towards including Indigenous knowledges into the science curriculum in Zimbabwe. Ten teachers were sampled purposively (Lincoln & Guba, 1985), and video recorded while teaching two science lessons after their consent and the students' parental consent had been solicited and given. The objective for video recording lessons was to observe and collect data reflecting the actual activities and events happening in the classroom. Semi-structured interviews were later conducted to supplement and complement insights (Morse, 1994)

gained through classroom observations. The study did not aim to attain representativeness and generalisability but to get thick descriptions of teachers' beliefs and attitudes hence the small sample size. All participants were fully qualified primary school teachers.

Findings

Teachers' beliefs and attitudes towards integrating Western science and Indigenous science in primary classrooms in Zimbabwe were found to be conceptual (teachers' definitions of science were mainly empirical), pedagogical (using empirical methods of teaching and very little of students' experiential knowledge), cultural (enculturation through Western education affected teachers' interpretations of science and how it should be taught), psychological (the feeling that Indigenous knowledge was inferior and irrational or colonial mentality disadvantaged the integration of Indigenous perspectives) and practical (unavailability of Indigenous teaching material did not make teaching Indigenous science possible). The attitudes were a result of systemic and institutional expectations on teachers.

Teachers' definitions and perceptions of science

Teachers' definitions and perceptions of science are vital to their pedagogical practices and how they value children's prior knowledge from their homes. When primary school teachers in this study defined science, their definitions were almost similar. The following meanings of science were gleaned from the interview data:

> Science is a subject about experimenting, finding out about things in general in everyday life. But, if you talk about "science" you can't run away from the "environment" because most of the things we will be teaching about have something to do with the environment (personal communication, 2007).

> Science ... involves the use of our senses and it is about manipulating and investigating things and also there are a lot of skills involved with it: communication skills, investigating skills, and also we have got what we call experimental skills (personal communication, 2007).

In addition to the above conceptualisation of science, other definitions provided involved ideas such as:

1. Manipulation of the environment;
2. The study of nature and how people interact with the nature;
3. Investigating things and experiments;
4. The use of our senses and it is about manipulating and investigating things.

Although the human aspect is identified in some of the definitions, culture is not explicitly identified as falling within the realm of science. The teachers perceived science primarily in its physical and empiricist form. Those who associated science with the study of the physical environment focused mainly on the empirical methods of studying science. They tended to exclude the social and cultural environment in their definitions.

The conceptualisation of science as objective and physical reality independent of culture seemed to have been influenced by the *Environmental Science Syllabus* that primary school teachers in Zimbabwe follow. The Syllabus emphasises "investigative science", which seeks to prove theories and finding evidence that supports prescribed "factual knowledge". The following processes where identified as scientific in studying science: experimentation, simulations, demonstrations, field trips, problem solving, project method, research method and case study. Teachers emphasised the dominant perspective of teaching science "investigation and experimentation" as the main methods they used in teaching science. The teaching techniques were designed in such a way that students were directed towards "discovering knowledge" that was already defined by the teacher, implying that it was as worth knowing. Although these pedagogical methods are hands-on, which give students practical experience when learning science, the Syllabus is silent in how teachers can integrate culture into the science curriculum.

Views on Indigenous knowledge and science

Regarding the relationship between Indigenous knowledge and science, two schools of thought emerged from the teachers. One group did not distinguish between Indigenous science and Western science in their teaching, while the other felt that school science was "Western" and Indigenous science was not "real science". These views mirrored what I had observed during science teaching in the teachers' classes. While in some classes teaching and learning situations seemed to be inclusive of "some" Indigenous knowledge, in others there was no attempt to incorporate it in science lessons.

Those teachers who argued for no separation between sciences indicated that science, whether "Western" or "Indigenous," belongs to the same domain of knowledge. Their argument was that differences are discernible in the way we derive meaning from and make sense of our different cultural worlds. They argued that:

> It would be very difficult to say this is traditional science. So, I wouldn't actually be very comfortable with the words traditional and Western. As much as possible I try to interact the two because there is no way that I may want to teach Western science

> without the traditional aspect in it because it is one that is so immediate to the children (personal communication, 2007).

> Well, it is going to be very difficult [to say] because we have been Westernised in such a way that we tend not to worry about this traditional science. But basically, whatever we teach, I think, is traditional science. Maybe, it is the language that we use and the things we use that are Westernised (personal communication, 2007).

These teachers seemed to be self-reflectively in favour of the link between Indigenous knowledge and school science, and appeared to be working towards merging the two. They did not marginalise or exclude the incorporation of Indigenous knowledge in science teaching. Neither were they skeptical nor cynical about Indigenous science. They believed that there is fluidity and complimentality between "Western" science and "Indigenous" science in Zimbabwe. Teachers in this group did not see boundaries between Indigenous science and formal science taught in primary schools in Zimbabwe. They understood science to be one body of knowledge that does not need any classification or categorisation into Western science or Indigenous science. Their perception was that science is the same everywhere:

> The science we teach is the same. In teaching you can't say this is Western science or Indigenous science, or this is an indigenous method of teaching science and this is a modern method. Maybe, what can only be indigenous could be the apparatus that you can use not the type of method of teaching (personal communication, 2007).

One teacher also argued using the traditional healing system as an example to support the idea that the science taught at school and that which is practiced in rural communities is the same, in spite of cultural differences:

> The science that we teach in school and the one practiced in the community is the same. Our traditional healers use plants as medicines, so I think that can be co-opted in teaching science (personal communication, 2007).

Although these teachers seemed very supportive of incorporating Indigenous knowledge in formal science, I could not clearly identify and distinguish it from the formal science they were teaching during lesson observations. It is possible that when they incorporate Indigenous science in their teaching, they do not do so deliberately, but unconsciously using Indigenous knowledge as examples used to support the importance of formal science, thus trivialising and undervaluing traditional scientific practices. The use of Indigenous knowledge becomes symbolic and rhetoric and deontologised into an object.

Those teachers who opposed the inclusion of Indigenous perspectives into the science curriculum were of the characteristic that was identified one teacher who described them as *Westernised* and *colonised*. These teachers categorically distinguished Indigenous knowledge from Western science. They did not perceive formal science as a construction and creation of Indigenous experiences. For them, cultural knowledge had no place in the formal science curriculum:

> What we are teaching is Western science [laughs]. Traditional science has no place in our curriculum in the teaching of science [laughs again]. Beliefs and customs do not have a place in teaching science. Traditional knowledge is important only at home. When teaching science, traditional beliefs have to be corrected. We need to correct such beliefs in pupils because here we are trying to explain causes of things (personal communication, 2007).

> Ah ... Indigenous knowledge usually has old values, which they carry for generations and hence you find that the experiences that the children have are usually the old information that they are taught by their elders. That information won't work, because you know, everything is developing. With IT (Information Technology) you can't always rely on the old methods of living (personal communication, 2007).

When teachers in this category were asked to explain why they felt that the two forms of science could not be taught together without any hierarchical classification, their responses tended to be cynical and demonise Indigenous knowledge, discounting it as illogical and irrational. Western science was glorified and described as rational, authentic and reliable reflecting the "truth":

> We need to correct traditional beliefs that pupils bring to school because they are not rational. If we allow them in class, we are not developing any science knowledge in the children. Indigenous knowledge is difficult to prove, very difficult to prove. Western science has proof, while Indigenous science, basically, lacks proof (personal communication, 2007).

> Right, science that exists in the community is not written and Western science is documented, we can have reference to it whereas ours we cannot (personal communication, 2007).

According to these teachers, school science and Indigenous knowledge are polarised, oppositional

and defined in their dual context of modernity and traditional. The concept of science was based on drawing a contrast between a "dynamic modern science" and a "static, traditional one," and between a "rational" West and a "mythical" Africa. The teachers' perceptions framed science hierarchically, with Western science accorded a higher "superior" status to Indigenous science, a hierarchical classification that was a result of colonial psychological ideology. This dualistic approach to science promotes unequal power distribution in knowledge recognition, dissemination and utilisation. The teacher seemed to view school science as impartial and authentic to all cultures. This view is embedded in hegemonic colonial constructs, which are self-defeating to and disenfranchise learners. It also disempowers learners since it silences many of their voices. The conflicts and unevenness characteristic of science practiced in school and outside the school are largely due to the pervasive influence of neo-colonisation and globalisation.

During my discussion with teachers in this category, most of them responded by shaking their heads when the idea of incorporating Indigenous knowledge into the teaching of school science was suggested to them. Usually, their negative body language was accompanied by cynical laughter. Even the tone of their voices was dismissive and at times conveyed a sense of disbelief and ridicule. These teachers were skeptical of Indigenous knowledge and seemed to prefer to continue teaching assimilative science that is not culturally sensitive to the cultural site in which this rural primary school is located. Jegede (2000) suggests that one way for teachers to avoid assimilative practices is to sensitively integrate students' Indigenous knowledge of nature with the content of Western science. In contrast, the responses I got from these teachers when I asked them why it was not possible to integrate Indigenous knowledge with school science were shrouded with caution, skepticism and negativism:

> We need to be very, very careful [says with stress] of traditional beliefs or customs in the teaching and learning of science. Some of the information that students bring might mislead teachers and other children (personal communication, 2007).

> Indigenous knowledge, traditional beliefs and customs are misleading in teaching science. For example, when we were doing a lesson on "Lightning" some children believed that a person can be struck by lightning for wearing red clothes. The community believes that and that knowledge is also within the children, they take it as true. But when we teach that topic we try to make the children understand that colour does not necessarily mean that you will be struck by lightning. It is being the highest point or nearest to a tall object or probably, if you are just close to where lightning is taking place that you get struck. So we can get rid of that belief that red clothes can make you get struck by lightning [laughs] (personal communication, 2007).

The teachers tended to promote the dominant perspective of Western science as the only form of interpreting meanings of natural phenomena thus making themselves validators and legitimators of science knowledge. Their understanding of "science" was deeply rooted in Euro-centricism and colonial education that may have influenced and shaped their thinking, vision and definition of reality. The teachers paid more attention to textbook science than to how the culture influenced how students learned science. They, consequently, did not respect the credibility of the reality that is defined by the socio-cultural confirmations of Indigenous cultural institutions. Through their negation of meaningful learning, these teachers may well be seriously undermining their efforts to create a safe and caring learning environment for their students.

Pedagogical and classroom practices

Classroom interactions have a bearing on inclusive teaching. How teachers respond to students' responses and encourage student-student interactions accounts largely for the learning outcomes of students. Inclusive practices mean treating all children without discrimination, and using language that is appropriate in encouraging students to voice their views and opinions. Some teachers in this study were keen on incorporating students' cultures in their teaching. One teacher explicitly explained how he incorporated multicultural teaching and contesting views on science teaching:

> Children come to school with traditional beliefs and customs that they acquire at home. For example, in one lesson we were talking about epidemics and natural disasters. We were discussing drought as a natural disaster that can happen because of environmental problems. But one child said to me, "Look teacher, there is chitwa, why can't we perform it?" Chitwa is a traditional culture, whereby elders brew beer for the rainmaking ceremony. That child asked me if it helps because this was happening in their community. With this belief in mind I was asking myself, "But does this help? Are we going to have rain after this ceremony?" I told the class that it was our culture. "It is practised. Yes, we can have rain". That's the traditional belief that I encountered in that lesson. But you still explain to them about the weather, the weather changes that sometimes affect the pattern of rain (personal communication, 2007).

Because of this classroom encounter and experience, the teacher ended rethinking and convinced about the importance of using cultural knowledge that students bring from home. This example highlights the sensitivity with which the teacher treated the student's question and how the teacher aptly included traditional practices into the teaching of a natural phenomenon. The teacher showed that it was possible to include Indigenous knowledge when teaching formal science, without devaluing students' cultural knowledge. When I observed this teacher teaching on *Material Change* I felt that he was doing his best to introduce knowledge diversity in formal science. Students freely discussed cultural issues that affected their everyday lives. Cultural activities and cultural artifacts were mentioned to bring science closer to home and community life. Later, when I discussed with the teacher about the place of Indigenous science in school science, the response was:

> Last week when we were talking about changes that are useful we talked about "molding and firing clay pots", it's something that happens in our traditional setup. Our grandmothers mold those things and fire them. So I think that's part of Indigenous science that we are taking into our lessons today. One boy also talked about "molding cattle", these are clay toys the boys make when they are herding cattle. It is a cultural pastime for them. "Molding" and "firing" make materials such as "clay" change. That is what my objective was in that lesson (personal communication, 2007).

Clay molding is an important aspect of life for both adults and children in rural areas. Adults use clay to make traditional pots for cooking meals in as well as for brewing beer and keeping water. Every rural household has these pots and are an important asset for rural women. Children, both girls and boys use clay to mold toys that usually imitate life in rural villages. These toys include clay cattle, dogs and goats, as well as clay pots and plates. Both adults and children make these clay objects strong by "firing" them in hot furnaces. Thus, science is much alive in rural communities and if this cultural knowledge is used in schools, it is likely to improve students understanding of formal science and, thus improve science learning outcomes.

A Grade 5 teacher stated that he had grown up in rural Zimbabwe and he suggested that perhaps, it was his socialisation that greatly influenced his approach to the teaching of science and how he incorporated cultural perspectives in it. The teacher's own socialisation into the family and community values, beliefs and customs had somehow motivated him towards teaching inclusive science:

> I come from a very remote and cultural family and my teaching involves what I have grown up experiencing. I learned those things as I was growing up and thus I accept what children believe in and try to bring it in my teaching. For example, when I was teaching a lesson on "Insects" I did not dispute a child who stated that locusts and white ants were destructive but had nutritious food value. Africans eat them as a source of proteins so it was traditional knowledge, which saved to develop the ideas that I wanted to teach (personal communication, 2007).

As one teacher pointed out earlier, it is our educational backgrounds, and being products of colonial education and Western hegemony that make us think that science is a Western concept. The education system that most teachers went through defined "science" as a Western empirical and rational body of knowledge, while Indigenous practices and ways of knowing were cynically perceived to be irrational and unscientific.

Language of interaction: The silencing monster

Language plays an important role in classroom interactions and in sharing ideas and information between teachers and students. It is both a communication tool as well as a vehicle for cultural transmission. One of the most frustrating and disconcerting classroom phenomena is the silence among some preadolescents and adolescents who will not or cannot actively engage in classroom discourse (Shizha, 2005b). The classroom environment is so threatening that students retreat into silence. Dialogue or voice is the basis of most classroom activities, and it enables students to share their thoughts and experiences with other students and the teacher. Without dialogue, there is likely to be "deafening silence" that could be undesirable or detrimental to classroom life. In some teachers' views, given the globalisation and internationalisation of English, it has become the language of science discourse at the expense of students' and even teachers' competence in the language. Teachers' attitudes to Shona, an Indigenous language had the effect of perpetuating the status quo of English as "the" science language. For example, one Grade 7 student was struggling to describe what he had done in a science activity to demonstrate that materials can change shape, form and size because he could not express himself fluently in English. When the student paused for a long time and struggled to get the English words to complete his thoughts, the teacher uttered, "*Stuck*!" The student thought that the teacher was helping him with the word to complete his sentence, so he repeated the word, and the teacher retorted, "No, I mean you are stuck, you can't find the right word to use".

Hearing this, some students together with the teacher laughed, thus embarrassing the student

who sat down looking down in shame. After that undesirable or detrimental encounter, the student did not want to participate any further in the lesson. The teacher failed to sympathise and empathise with the student. The attitude of the teachers and other students towards those who used Shona in class caused resentment and self-pity that imprisoned students in their silence. The teacher was neither concerned with assisting students to understand science in their own language nor in promoting inclusive science that cuts across language barriers. The teacher was more concerned with science narratives and discourses that met international recognition and "standards" than discourses that enhanced students' understanding and positive learning outcomes.

Sometimes students were observed showing hopelessness and despair while attempting to communicate their ideas. This was a result of teachers who imposed an English-only discourse in their teaching. The teachers were observed discouraging students from responding to questions in their mother language. In some instances the teachers responded by mocking students who used an Indigenous language in the lesson. In one such example, a teacher who was teaching a Grade 5 class about "houseflies" had the following exchange with students:

> Teacher: What do [house] flies feed on?
>
> Student 1: Sadza [a staple food in Zimbabwe].
>
> Teacher: Ehe! What else?
>
> Student 2: Faeces [human waste].
>
> Teacher: Ehe!
>
> Student 3: Ndove [cow dung].
>
> Teacher: [With a mocking voice]: Shall I have to write ndove on the board?

The tone of the teacher's voice and question caused the other students to laugh and the teacher repeated the question with the same tone of voice:

> Teacher: Shall I have to write that on the board? A Grade 1 child should say that. If a Grade 5 child can say that, what then should a Grade 1 child say? Say it in English!

The teacher was not sensitive to the language problems that the student was facing, and displayed an attitude that made those who were not able to express themselves in English reluctant to participate in the lesson. The importance attached to language in communicating ideas and sustaining conversation cannot be emphasised. Whatever drives adolescents to silence, withdrawal, fear of engaging in dialogue, or reluctance to contribute to discussion and enquiry in the classroom deprives them from sharing their knowledge and experiences, and simultaneously, denies the teacher and other students from benefiting from the diversity of ideas that are likely to emanate from the students' experiences (Shizha, 2005b).

Teachers who enforce the use of English-only discourse in their classrooms and discourage the use of Indigenous languages are engaging in "verbal repression". They repress and push students into becoming unwilling and non-participatory students. In the end, the hostile classroom environment, which lacks compassion, care and love, silences the learners. Silence among adolescents could disrupt and interrupt the dialogical situations that transform classrooms into caring and compassionate communities. Usually the students become reluctant participants in class discussions and withdraw from interacting with the teacher. In so doing, they withhold information that may be vital to their understanding of science in the class. The language that the teacher demands students to use can therefore become a barrier to self-expression and rewarding learning experiences.

While I was observing a Grade 7 class going through a lesson on "Map Reading: Lines of Longitude and Latitude", the teacher conducted the entire lesson in English. Although the students appeared very attentive, when the teacher asked questions, very few of them responded. The problem seemed to arise from the teacher's persistence in using English and urging students to also use English to explain their answers. At one point in the lesson, the teacher interjected when a student began to respond to a question in Shona:

> You should always try to answer in English. Are you going to use Shona in the examination? The examination has no Shona questions and you are not going to be asked to answer in Shona. Now go on in English.

The student gave up and sat down and the teacher did not bother to assist the student any further. Instead the teacher went on to ask another student to respond to the same question. Rather than acting as a facilitator of learning the teacher was an inhibitor of the learning process. This was evidence of disruption of significant conversations. What seemed to be happening in this class was that certain conversations that were conducted in English were explicitly legitimated as having a privileged status since the teacher, the authority figure, accorded them legitimacy. On the other hand, conversations conducted in Shona were delegitimised and dismissed as unworthwhile feedback. Teachers who disregarded the use of an Indigenous language as an active learning tool treated students' responses as unimportant and irrelevant. In the process they

disrupted the conversation process since the science conversation mode; the English language in this case, was disaffiliated from the student, hence discouraging active learning and promoting docility and silence.

Although some teachers, in my study, would rigidly try to enforce the use of English as required by policy makers and school administrators, others allowed this interplay between languages, which they also used themselves, as the following dialogical exchange recorded in a Grade 4 class shows:

> Teacher: Let's look at those insects that fly. I think we have got a lot of them.
>
> Student: Bete [cockroach].
>
> Teacher: Hmm ... what do we call it in English?

There was no response to the teacher's question.

> Teacher: Cockroach ... Hatidzizive? Mapete akazara munyika? [Don't we know them? Cockroaches are many in the country]. Name another insect.
>
> Student: Chipfukuto [weevil].
>
> Teacher: [laughs] what do we call it? Tinogona kungochinyora [Let's write it without its English name]. Do you know mbuya-mbuya? Mbuya-mbuya tinovaziva? Do you know its name in English? She is called the praying mantis.

The above exchange shows how the teacher was code switching between English and Shona in order to make science meaningful to students. Code switching, though discouraged by some teachers, was widely observed being used. It was used in both the teachers' and students' discourse. In some cases it seemed like an automatic and unconscious behavior, while in others it was purposively used to enhance understanding in students. Although code switching seemed to be correlated with the deficiency in English linguistic competence, it gave students the space and language to cross boundaries of scientific differences. As Freire (1985) explains, the interplay between the languages provided students with a language of hope, possibility and empowerment, and a language to share life and knowledge experiences.

Conclusion

The idea that teachers are the most influential factors in educational change and students' learning outcomes is not controversial. Teachers' beliefs about teaching and curricular content are important in achieving curriculum change and in assisting students to succeed in academic work. Whereas the goal of conventional science teaching has been to transmit to students the knowledge, skills, and values of the scientific, school science conveys a particular Eurocentric worldview because it is a subculture of Western (Euro-American) culture. Studies on cultural beliefs and science in Africa, including the present study, conclude that the teaching and learning of science in school is not successful because the subject is not linked to everyday life experiences of the students and the language of instruction alienates students. Both teachers and students are crippled by English, the medium of instruction, which is a foreign language to them. Science teaching should foster socially patterned experiences and the social processes that are concretely lived and negotiated in a language familiar to the teacher and students. Some of the lived experiences may not appear in science syllabus or in examination questions, but they are vital in assisting and enhancing students' understanding of school science. Learning is not only about passing examinations but also to help students make sense of their physical, social and spiritual world. In other words, it is about negotiating their worldviews and improving their lives.

While distinctions, from the dominant perspective can be made between common sense knowledge or everyday knowledge and school knowledge, one may argue that school knowledge is the everyday knowledge of those with the power to define knowledge and legitimise knowledge that is regarded as rational or scientific. In Zimbabwe and other societies, the cultural and everyday knowledge of the dominant groups in society is framed as school knowledge. School knowledge cannot be divorced or separated from the cultural knowledge of those who define what constitutes scientific knowledge. School science is a component of dominant culture that in large doses ignores the cultural knowledge of the subjugated and marginalised Indigenous people. Consequently, colonial knowledge still dominates the science education and teachers' perspectives, attitudes and beliefs about science in Zimbabwe.

Acknowledgements

I would like to thank the hardworking and struggling teachers and the head teacher of the rural school in Zimbabwe who provided data for this study. This study could not have been possible without their willingness to spare their time to talk with me and without their consent, and the parental consent of the students whose classes were video recorded during data collection. Last, but not least, a big thank you to the students who eagerly and enthusiastically made the study interesting through their responses during class activities. Ndinotenda mose (Thank you all).

References

Aikenhead, G. S. (1997).Toward a First Nations cross-cultural science and technology curriculum. *Science Education, 81*, 217-238.

Arua, E. A. & Magocha, K. (2002). Patterns of language use and language preference of some children and their parents in Botswana. *Journal of Multilingual and Multicultural Development, 23*(6), 449-461.

Ball, J. (2004). *Early childhood care and development programs as hook and hub: Promising practices in First Nations communities*. Victoria, BC: University of Victoria.

Bamgbose, A. (1984). Mother tongue medium and scholastic attainment in Nigeria. *Prospects, 16*(1), 87-93.

Bryan, L. A., & Atwater, A. A. (2002). Teacher beliefs and cultural models: A challenge for science teacher preparation programs. *Science Teacher Education, 86*, 821-839.

Bunyi, G. (1999). Rethinking the place of African indigenous languages in African education. *International Journal of Educational Development, 19*, 337-350.

Chick, J. K. (2002). Constructing a multicultural national identity: South African classrooms as sites of struggle between competing discourses. *Journal of Multilingual and Multicultural Development, 23*(6), 462-478.

Clark, J., & Ramahlape, K. (1999). Crackles and sparks: Stepping out of the world of lightning with the Science Through Application Project (STAP). In J. Kuiper (Ed.), *Proceedings of the Seventh Annual Meeting of the Southern African Association for Research in Mathematics and Science Education* (pp. 110-120). Harare, Zimbabwe: University of Zimbabwe.

Cleghorn, A. (1992). Primary level science in Kenya: Constructing meaning through English and indigenous languages. *International Journal of Qualitative Studies in Education, 5*(4), 311-323.

Curriculum Development Unit. (1994). *Primary school environmental science syllabus: Grade 6 and 7*. Harare, Zimbabwe: Ministry of Education and Culture.

Freire, P. (1985). *The politics of education: Culture, power, and liberation*. South Hadley, MA: Bergin & Garvey.

Harding, S. (1994). Is science multicultural? Challenges, resources, opportunities, uncertainties. *Configurations 2*(2), 301-330.

Jegede, O. J. (2000). Making science globally owned, accessible and relevant in a postmodern world. Unpublished report to the American Educational Research Association Annual Meeting, New Orleans, Los Angeles, United States of America.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. New York, NY: Sage.

Makhurane, P. (2000). Science and technology in Zimbabwe in the millennium. *Zimbabwe Journal of Educational Research, 12*(3), 62-79.

McConaghy, C. (1998). Constructing Aboriginality, determining significant difference. In T. Maxwell (Ed.), *The context of teaching* (pp. 121-139). Armidale, NSW: Kardoorair Press.

Michie, M. (2002). Why indigenous science should be included in the school science curriculum. *Australian Science Teachers' Journal, 48*(2), 36-40.

Morse, J. M. (1994). Emerging from the data: The cognitive process of analysis in qualitative inquiry. In J. M. Morse (Ed.), *Critical issues in qualitative research methods* (pp. 23-43). Thousand Oaks, CA: Sage.

Murila, B. (2004). Use of science textbooks in Kenyan schools. In A. Peacock & A. Cleghorn (Eds.), *Missing the meaning: The development and use of print and non-print text material in diverse school settings* (pp. 121-132). Basingstoke, UK: Palgrave MacMillan.

Ninnes, P. (2000). Representations of indigenous knowledge in secondary school science textbooks in Australia and Canada. *International Journal Science Education, 22*(6), 603-617.

Ogunniyi, M. B. (2007). Teachers' stances and practical arguments regarding a science-indigenous knowledge curriculum: Part 1. *International Journal of Science Education, 29*(8), 963 – 986.

Seweje, I. O. (2000). The challenge of science teaching in Nigeria today. *Journal of Educational Foundations and Management, 1*(1), 208-220.

Shizha, E. (2005a). Reclaiming our memories: The education dilemma in postcolonial African school curricula. In A. Abdi & A. Cleghorn (Eds.), *Issues in African education: Sociological perspectives* (pp. 65-84). New York, NY: Palgrave Macmillan.

Shizha, E. (2005b). Book review of Bosacki Sandra,"The culture of classroom silence". *Education Review: A Journal of Book Reviews (November 30)*. Retrieved 16 January, 2008, from http://edrev.asu.edu/reviews/rev443.htm.

Shizha, E. (2006). Legitimizing indigenous knowledge in Zimbabwe: A theoretical analysis of postcolonial school knowledge and its colonial legacy. *Journal of Contemporary Issues in Education, 1*(1), 20-35.

Shizha, E. (2007). Critical analysis of problems encountered in incorporating indigenous knowledge in science teaching by primary school teachers in Zimbabwe. *Alberta Journal of Educational Research, 53*(3), 302-319.

Thomson, N. (2003). Science education researchers as orthographers: Documenting Keiyo (Kenya) knowledge, learning and narratives about snakes. *International Journal of Science Education, 25*(1), 89-115.

Warren, D. M. (1991, May). *The role of indigenous knowledge in facilitating the agricultural extension process*. Paper presented at International Workshop on Agricultural Knowledge Systems and the Role of Extension, Bad Boll, Germany.

About the author

Dr Edward Shizha is an Assistant Professor in the Department of Contemporary Studies and Children's Education and Development at Wilfrid Laurier University (Brantford) in Canada. His teaching and research interests are in contemporary social problems and education including issues on globalisation, post-colonialism, and Indigenous education in Africa. He has published articles that have appeared in a number of journals including *International Education Journal*, *The Alberta Journal of Educational Research* and *Journal of Contemporary Issues in Education*, and book chapters have been published in *Issues in African Education: Sociological Perspectives* (2005) and *African Education and Globalization: Critical Perspectives* (2006).